

REMARKS

Claims 1-3 and 5-9 have been rejected under 35 USC 103(a) as being unpatentable over Takei et al in view of Kumagai. Claims 1-3 and 5-9 have been rejected under 35 USC 103(a) as being unpatentable over Takei et al in view of Kumagai and further in view of Rasshofer. Claims 1-3 and 5-9 have been rejected under 35 USC 103(a) as being unpatentable over Takei et al in view of Kumagai and Rasshofer and further in view of Sato et al. Applicants once again respectfully traverse these grounds of rejection and urge reconsideration in light of the following comments.

As explained previously, the instant invention is directed to a pre-resin mixture comprising a polyol, a polyisocyanate and a silane coupling agent containing an imidazole group. The ratio NCO/OH of the number of isocyanate groups in the polyisocyanate to the number of hydroxyl groups in the polyol in the pre-resin mixture is from 0.6 to 4.0 and the weight ratio of polyol and polyisocyanate to the silane coupling agent containing an imidazole group is from 100:0.01 to 100:10 and the silane coupling agent containing an imidazole group is a reaction product of a reaction mixture consisting of either (1) an imidazole compound and 3-glycidoxypropyltrimethoxysilane or (2) an imidazole compound and 3-methacryloxypropyltrimethoxysilane and has a hydroxy group in its molecule when it is obtained by reaction of an imidazole compound and 3-glycidoxypropyltrimethoxysilane and does not have a hydroxy group in its molecule when it is obtained by a reaction of an imidazole compound and 3-methacryloxypropyltrimethoxysilane.

In the present invention, the silane coupling agent containing an imidazole group reacts with a polyisocyanate or a polyol to form a three-dimensional network in the resin to enhance the properties of the cured resin. The silane coupling agents of the present invention itself joins in the network structure to create a more developed network

structure. It is respectfully submitted that the prior art cited by the Examiner does not disclose the presently claimed invention.

The Takei et al reference discloses the preparation of polyurethanes by a process in which a vinyl-based monomer is polymerized in the presence of an alcohol having no addition-polymerization activity by using an initiator consisting essentially of peroxide and at least one catalyst selected from the group consisting of an organic sulfonic acid compound having no addition-polymerization reactivity and an inorganic acid. As admitted by the Examiner, there is no disclosure in this reference with respect to using a silane coupling agent containing an imidazole group in the polymerization reaction. In fact, Takei et al specifically states that the reactor does not substantially contain any other component than the named vinyl-based monomer, alcohol, peroxide and catalyst.

The Kumagai reference discloses an organosilicon compound which can be used as a surface-treating agent for improving the adhesion of a metal, such as copper, steel or aluminum, or an inorganic substance, such as glass fibers, silica, aluminum oxide or aluminum hydroxide, to a resin. Kumagai also discloses that the organosilicon compound can be used as a resin additive for a thermoplastic or thermosetting resin, with an epoxy resin being specifically exemplified. Example 3 of Kumagai discloses that an epoxy resin composition, which is a mixture prior to the initiation of the reaction to make the epoxy resin by polymerization and is composed of a prepolymer and curing agent, is mixed with about 1% of imidazole silane B, curing of the epoxy resin composition initiated by heating to promote the curing of the resin and improve the mechanical strength thereof.

In Kumagai, the nitrogen atoms included in the imidazole groups of the imidazole group-containing silane coupling agent have the characteristics of a tertiary amine and thus the imidazole compound has the function of promoting the reaction of an epoxy resin in the prepolymer phase and in the presence

of a curing agent. As such, the imidazole compound does not join the network formed by the polymerization and does not become a part of the resultant resin and, instead, remains a compound or impurity in the mixture in the resin. Example 3 of this reference specifically discloses the curing reaction is between the epoxy resin in the prepolymer phase and a curing agent and since the epoxy resin and curing agents successively react to form the polymer, the resulting polymer basically has a two-dimensional structure.

In contrast to the disclosures of Kumagai and Takei, in the present invention, in addition to the polymerization reaction as a urethane formation of an epoxy silyl group and a hydroxyl group included in the imidazole group-containing silane coupling agent with a hydroxyl group in a polyol or an isocyanate group in a polyisocyanate progresses, the silane coupling agent also reacts as part of the polymerization reaction so that the polymerization is mediated by the silane coupling agent and a three-dimensional network is formed. This type of reaction network occurs in the polymerization occurring during the formation of an epoxy resin as exemplified in Kumagai. Moreover, there was no recognition of the possibility, at the time of the invention of Kumagai, that the imidazole group-containing silane coupling agent would be directly involved in the reaction of the polyurethane formation to form a three-dimensional network. As such, it is respectfully submitted that the presently claimed invention is patentably distinguishable over the combination of Kumagai and Takei et al.

The Rasshofer reference is directed to laminates comprising metal and compacted or cellular polyurethane resins. The Examiner has cited this reference as showing that 1,2-dimethylimidazole and 2-methylimidazole are known catalysts in reactions that form polyurethanes. Applicants readily admit that imidazole compounds have been used as catalysts in urethane-forming reactions. However, as argued in previous Responses, the present invention was arrived at in

order to avoid the unpleasant odor generated when using a tertiary amine compound as a catalyst in a reaction of a polyol in a polyisocyanate and to improve the curing and adhesion of a resin composition to metals, inorganic materials and organic materials. The imidazole disclosed in this reference is not an imidazole group-containing silane coupling agent and there is nothing in this reference that suggests the use of the silane coupling agent in a reaction generating the polyurethane. Therefore, this reference in combination with the previously discussed references does not present a showing of prima facie obviousness under 35 USC 103(a).

The Sato reference discloses glass fabrics and a glass-fabrics reinforcing resin laminate sheet which can be used as a printed circuit board. Sato has been cited by the Examiner as teaching a finishing agent for the glass fabrics which is a reaction product of an imidazole compound with an amine reactive group and a silane coupling agent and that the silane coupling agent can comprise  $\gamma$ -glycidoxypropyltrimethoxysilane. The Examiner also says that this reference teaches that the finishing agent can act simultaneously as a catalyst in a coupling agent. As pointed out by Applicants in a previous Response, the "catalyst" function of this reference means a catalyst in the promotion of a reaction of the functional group of a silane coupling agent and a matrix resin at the glass/resin interface and not a catalyst during the synthesis of the resin. The silane coupling agent is applied to the surface of a substrate and the silane coupling agent only exists on the surface thereof. In contrast thereto, in the present invention, the silane coupling agent is incorporated completely into the resin composition in order to make it responsible for the curing reaction and results in the composition of the resultant coating film. The present invention results in a notable effect of the coating film adhering to the substrate from the reaction during the process of the curing and this is clearly unexpected in light of the Sato reference in combination with the previously discussed

references. As such, Applicants once again respectfully assert that the Examiner has not even made a showing of prima facie obviousness under 35 USC 103(a) with respect to the presently claimed invention.

As discussed in the previous Response, test data is of record in the present application which is more than sufficient to rebut any proper showing of prima facie obviousness under 35 USC 103(a). On pages 8-14 and in Figure 1 of the present specification, objective test data is presented which shows the unexpected benefits gained by using the silane coupling agent containing an imidazole group of the present invention. In Examples 1 and 2 and Comparative Examples 1-4, the curing promotion effect of an imidazole group-containing silane coupling agent of the present invention was evaluated against 3-glycidoxypropyltrimethoxysilane as a common silane coupling agent in Comparative Example 1, 2-ethyl-4-methylimidazole as a conventional imidazole catalyst in Comparative Example 2 and triethylamine in Comparative Example 3. As discussed in paragraph [0029], in the reaction system in which an imidazole group-containing silane coupling agent was added, the residual isocyanate group content was lower than that of the system to which no catalyst was added.

In Examples 3 and 4 and Comparative Examples 5-11, the contribution of the imidazole group-containing silane coupling agent to the increased adhesion to a base material was evaluated. Examples 3 and 4 use imidazole silane compounds according to the present invention while Comparative Example 5 used 3-glycidoxypropyltrimethoxysilane, Comparative Example 6 used 3-aminopropyltriethoxysilane, Comparative Example 7 used 3-mercaptopropyltrimethoxysilane, Example 8 used 2-ethyl-4-methylimidazole and Comparative Examples 9 and 10 used tertiary amines. As shown in the results contained in Table 1, the imidazole silane compounds of the present invention resulted in the resin composition exhibiting

superior adhesion. This is clearly not suggested by the prior art cited by the Examiner.

The corrosion resistance effect of the imidazole group-containing silane coupling agent of the present invention was evaluated in Examples 5 and 6 and Comparative Examples 12-15. In Examples 5 and 6, imidazole silane compounds of the present invention were used while Comparative Example 12 used 3-aminopropyltriethoxysilane, Comparative Example 13 used 2-ethyl-4-methylimidazole and Comparative Example 14 used a tertiary amine. As shown in Table 2, the imidazole silane coupling agents of the present invention resulted in an increased corrosion resistance as compared to the comparative additives while still eliminating the unpleasant odor associated with conventional tertiary amine catalysts. The test results discussed above are clearly sufficient to establish the patentability of the presently claimed invention over the prior art cited by the Examiner.

Applicants have provided test data that clearly illustrates that the presently claimed silane coupling agent provides unexpected benefits over conventional imidazoles cited in the prior art. As such, it is respectfully submitted that the patentability of the presently claimed invention has clearly been established. The Examiner is respectfully requested to reconsider the present application and to pass it to issue.

Respectfully submitted,

  
Terryence F. Chapman

TFC/smd

FLYNN, THIEL, BOUTELL  
& TANIS, P.C.  
2026 Rambling Road  
Kalamazoo, MI 49008-1631  
Phone: (269) 381-1156  
Fax: (269) 381-5465

Terryence F. Chapman	Reg. No. 32	549
Liane L. Churney	Reg. No. 40	694
Brian R. Tumm	Reg. No. 36	328
Heon Jekal	Reg. No. 64	219
Eugene J. Rath III	Reg. No. 42	094
Dale H. Thiel	Reg. No. 24	323
David G. Boutell	Reg. No. 25	072
Sidney B. Williams, Jr.	Reg. No. 24	949

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